Managing and Restoring Riparian Areas in Western Firescapes

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Fire Science Workshop
Columbia Basin Federal
Caucus & Ecotrust
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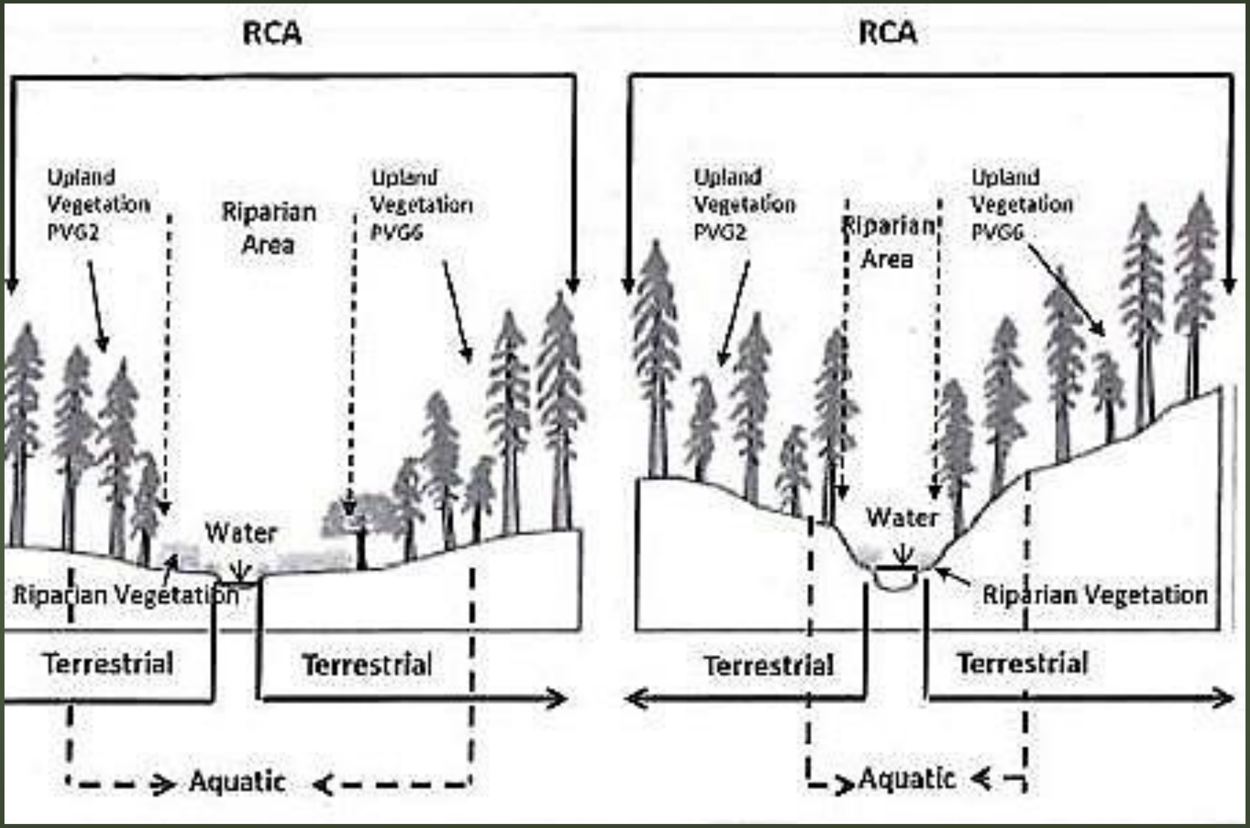
Riparian Conservation Areas (RCAs, USFS R4)

Low gradient, wide

Moderate gradient, confined



RCAs:

Zone of intergradation of terrestrial and aquatic ecosystems; includes components of both.

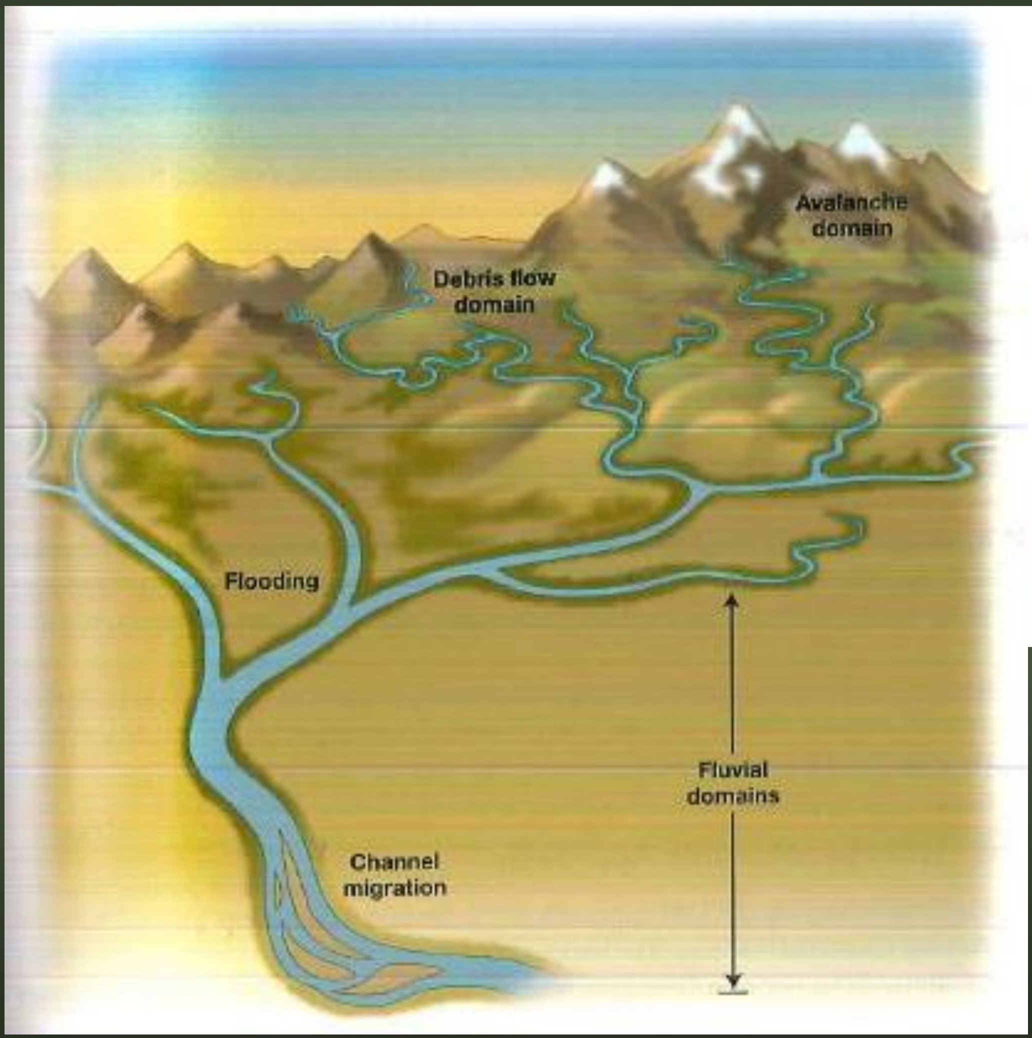
Width of RCA related to stream size, position within drainage areas, hydrologic regime, & site-specific geomorphology.

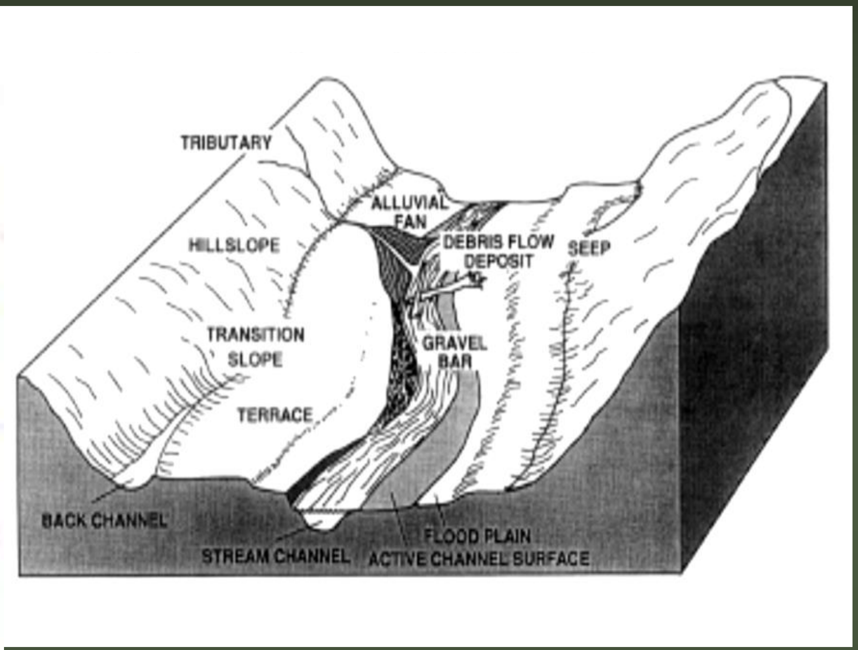
USDA Forest Service 2012 Planning Rule: Riparian is defined as " the transition between aquatic and upland…." (lake, pond, stream, river).

Riparian Areas: Influenced by Process Domains

Landscape Scale

Reach Scale





Location within the stream network?
Dominant upstream & upslope processes?

(Adapted from Montgomery 1999, Naiman et al. 2005)

Riparian vegetation can be highly variable & diverse.

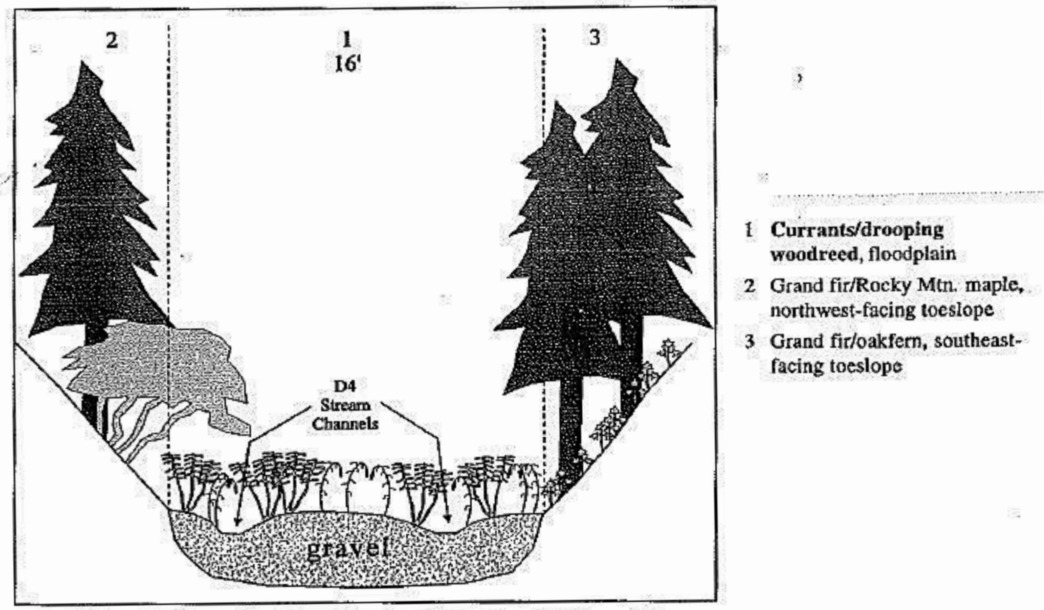


Figure 52. *N. Fk. Walla Walla River, Walla Walla RD, Umatilla NF; mod. low gradient, mod. elevation, V-shaped valley; Mesic Forest Zone 2.*

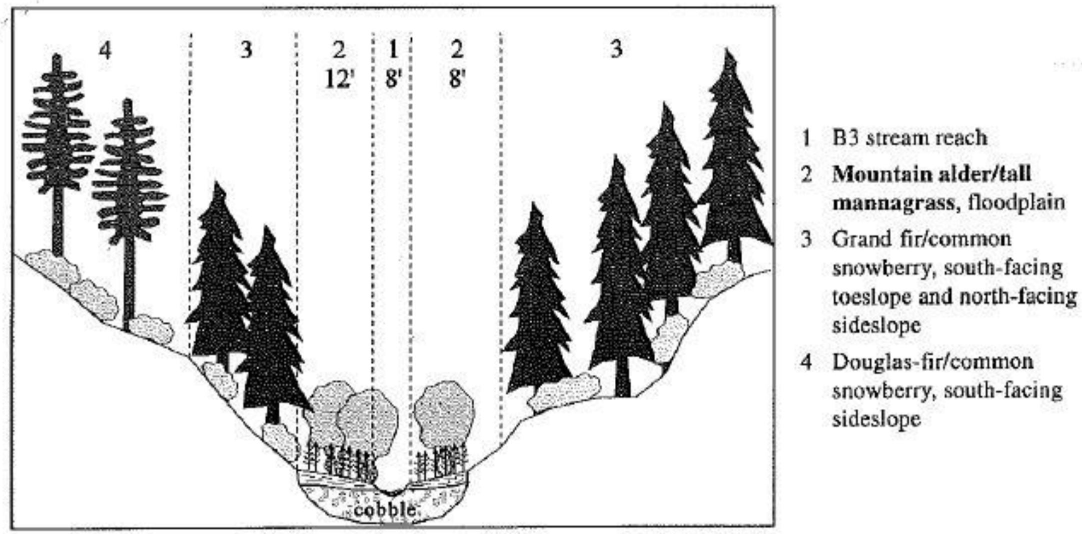
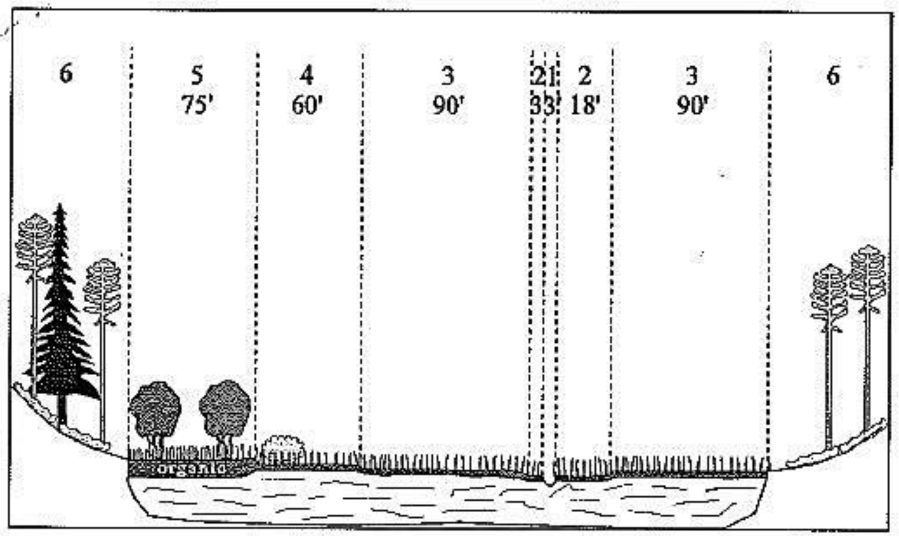


Figure 46. *Snow Fork, Pine RD, Wallowa-Whitman NF; high gradient, mod. low elevation, V-shaped valley; Mesic Forest Zone 2*

Varies with:

- Elevation
- Aspect
- Hillslope steepness
- Valley bottom width & characteristics
- Local geomorphic & soil surfaces
- Land use history
- Natural disturbance.

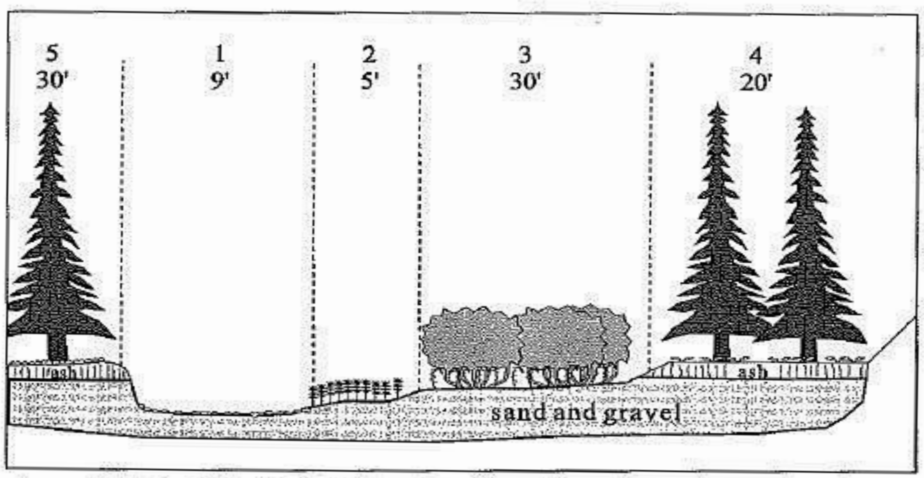
Crowe and Clausnitzer 1997. PNW-R6-NR-ECOL-TP-22-97.



1 E5 stream reach
2 **Aquatic sedge**, wet meadow-floodplain
3 **Bladder sedge**, wet meadow-floodplain
4 **Undergreen willow/ bladder sedge**, wet meadow
5 **Mountain alder/bladder sedge**, wet meadow
6 Lodgepole pine (subalpine fir)/grouse huckleberry, northwest- and southeast-facing sideslopes

Figure 67. *Lake Creek, North Fork John Day RD, Umatilla NF; very low gradient, mod. high elevation, flat-shaped valley; Mesic Forest Zone 1.*

Highly diverse vegetation on variable & dynamic substrates.



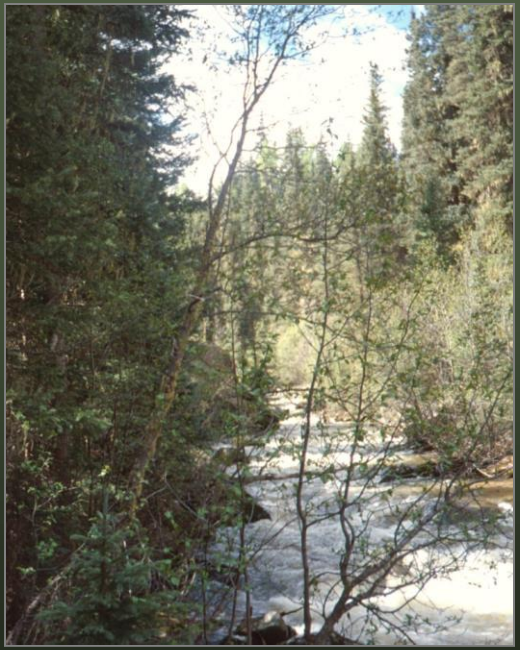
1 C4 stream reach
2 **Common horsetail**, point bar
3 **Sitka alder/drooping woodreed**, floodplain
4 Subalpine fir/queen's cup beadlily, terrace
5 Subalpine fir/twinflower, terrace

Figure 84. *N. Fk. Cable Creek, North Fork John Day RD, Umatilla NF; mod. low gradient, mod. elevation, V-shaped valley; Mesic Forest Zone 1.*

Crowe and Clausnitzer 1997. PNW-R6-NR-ECOL-TP-22-97.

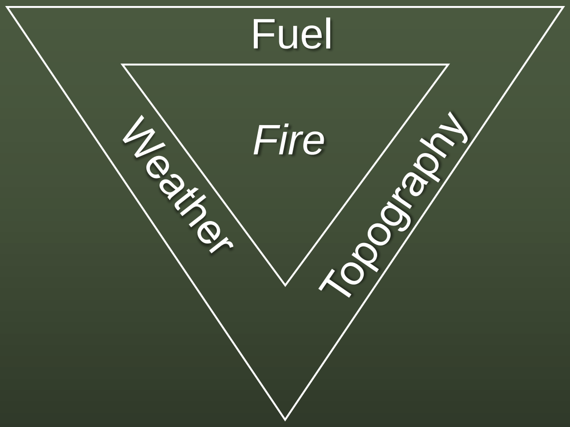
Riparian Vegetation Relative to Uplands

- Close interactions with stream; dependence on seasonal flows, localized areas of saturation; varies with stream size;
- Higher spatial heterogeneity;
- Greater proportion of deciduous cover – trees & shrubs;
- Edge dominated;
- More dynamic; faster species turnover in response to more frequent disturbance;
- Structured by geomorphic processes.



Properties & Behavior of Fire in Riparian Areas

<u>Vegetation – Fuel Characteristics</u>
Biomass (“loading” mass/area)
Bulk Density (mass/volume)
Size Distribution (SA/volume)
Chemistry (volatiles vs. nonvolatiles)
Ratio: live/dead
Shading/ exposure
Strata (surface, understory, overstory)
Continuity (horizontal & vertical)



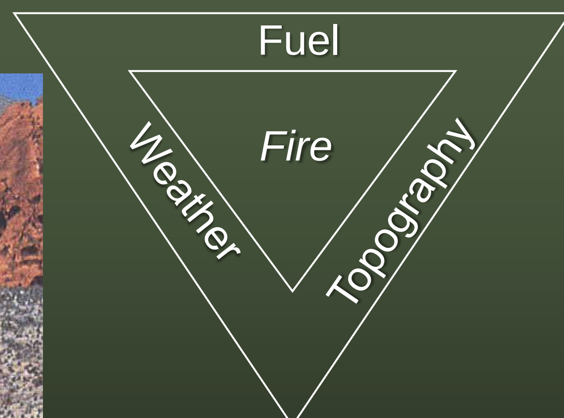
Fire Environment Triangle
(Pyne et al. 1996)

Ryan 2001. *Global change and wildland fire*. pp 175-183. RMRS-GTR-42

Properties & Behavior of Fire in Riparian Areas

Physical Features

- Microclimate
- Basin topography
- Basin & channel geomorphology



Fire Environment Triangle
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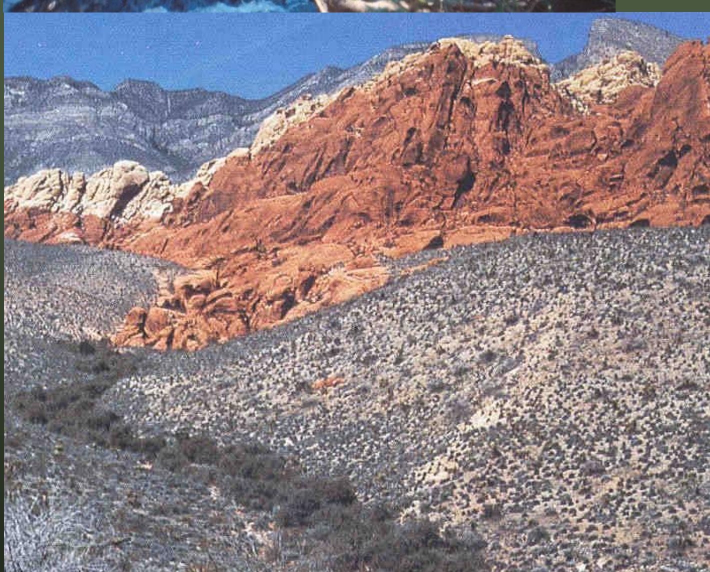
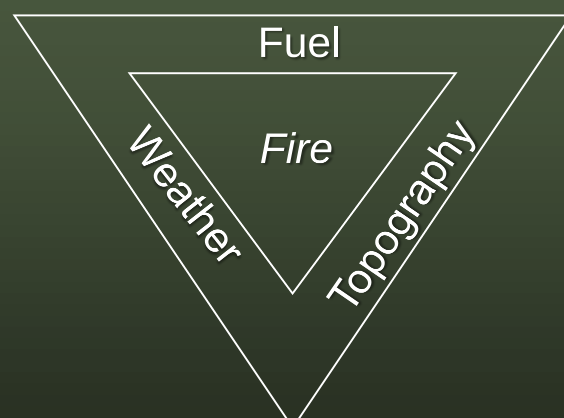


Properties & Behavior of Fire in Riparian Areas

Physical Features
Surface Water
Saturated Soils



Fire History in Riparian Areas

Challenges of reconstructing riparian fire histories:

- Methodological constraints;
- Frequent natural disturbances affecting streamside areas (flooding, debris flows);
- Many riparian areas have been severely altered (grazing, beaver removal, logging, mining, flow alteration);
- Limited understanding of natural fire dynamics, reference fuel loads, historic range of variability; understudied vegetation types and geographic regions;
- Discrepancies in published information.


Tower Fire (1996) NE Oregon

Riparian Areas and Upland Fire Regimes

1. **Burn like adjacent uplands; i.e. wildfires burn with similar frequency & severity;**

2. **Burn less frequently and/ or less severely than adjacent uplands;**

3. **Burn more frequently and/or severely than adjacent uplands;**

4. **Riparian serve as fire breaks.**

Luce et al. 2012. *Climate change, forests, fire, water, and fish: Building resilient landscapes, stream, and managers.* RMRS-GTR-290

Fire Return Intervals in Forested Riparian Areas

Location	Forest Type	Riparian Fire Return Interval (yrs)	Sideslope Fire Return Interval (yrs)	Citation
Blue Mountains, OR	Dry, Douglas-fir and Grand Fir series	13-36	10-20	Olson 2000
Elkhorn Mountains, OR	Dry, Ponderosa Pine, Douglas-fir series	13-14	9-32	Olson 2000
Salmon River Mountains, ID	Dry, Ponderosa Pine and Douglas-fir series	11-19	9-29	Barrett 2000
Cascade Range, WA	Dry, Ponderosa Pine and Douglas-fir series	15-26	11-19	Everett et al. 2003
No. Sierra Nevada Mtns, CA	Dry, Ponderosa/ Jeffrey Pine	10-87	10-56	Van De Water & North 2010
Dry Forest Type Average		**12-36**	**10-31**	
Cascade Range, OR	Mesic, Douglas-fir series	35-39	27-36	Olson and Agee 2005
Klamath Mountains, CA	Mesic, Douglas-fir series	16-42	7-13	Skinner 1997
Mesic Forest Type Average		**26-41**	**17-25**	

Stone et al. 2010. Fuel reduction management practices in riparian areas of the western USA. *Environmental Management 46:91-100.*

Post-Fire Recovery: Riparian Species

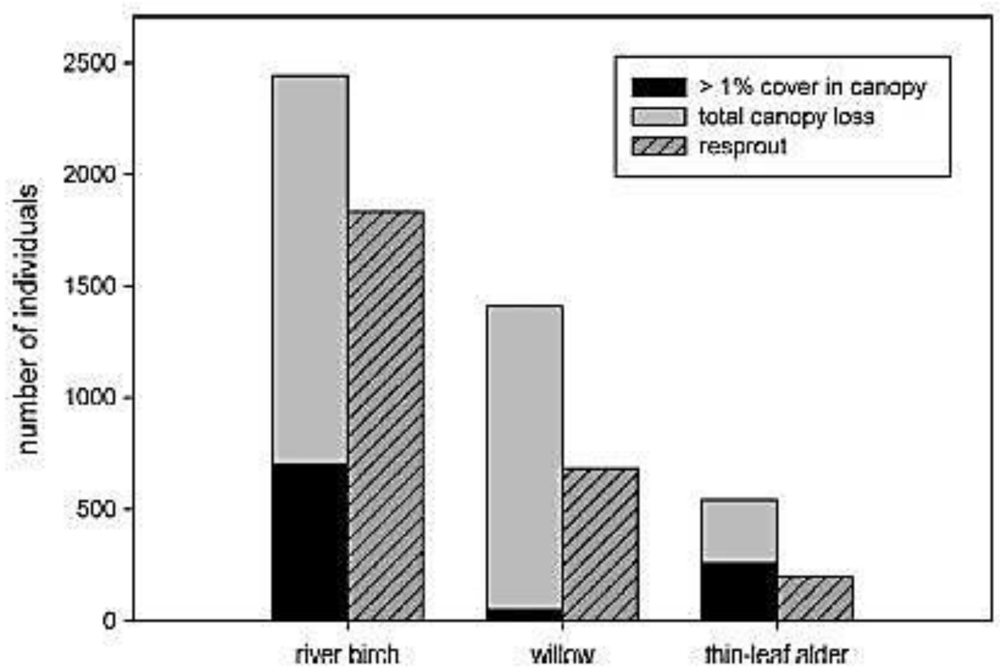


Fig. 1. Number of burned individuals with total canopy loss (100% canopy loss) and those with >1% canopy cover remaining. These are paired with the number of individuals resprouting. River birch = *Betula fontinalis*; willow = *Salix* spp.; thin-leaf alder = *Alnus incana* ssp. *tenuifolia*.

Basal Resprouting of Shrubs:

1st year post-fire:

- 74% river birch;
- 45% willow;
- 35% thin-leaf alder

2nd year post-fire resprouting:

- 84% river birch;
- 55% willow;
- 62% thin-leaf alder

Complete canopy loss: 71% of river birch plants ; 91% of willow plants; 51% of thin-leaf alder plants.

Recovery is strongly influenced by herbivory.

Kaczynski and Cooper. 2015. Post-fire response of riparian vegetation in a heavily browsed environment. *Forest Ecology and Management 338: 14-19.*

Post-Fire Recovery: Riparian Species

Species	Common Name	Sept 2002	June 2003 (new individuals)	Sept 2003 (new individuals)
Rosa woodsii	Wood's rose	13	22	12
Pachistima myrsinities	Mountain boxwood	16	4	13
Ribes lacustre	Black gooseberry	37	8	4
Symphoricarpus alba	Snowberry	10	6	1
Salix boothii	Booth's willow	81	1	9
Amelanchier alnifolia	Serviceberry	35	1	5
All Species		**332**	**381 (+ 49)**	**439 (+58)**

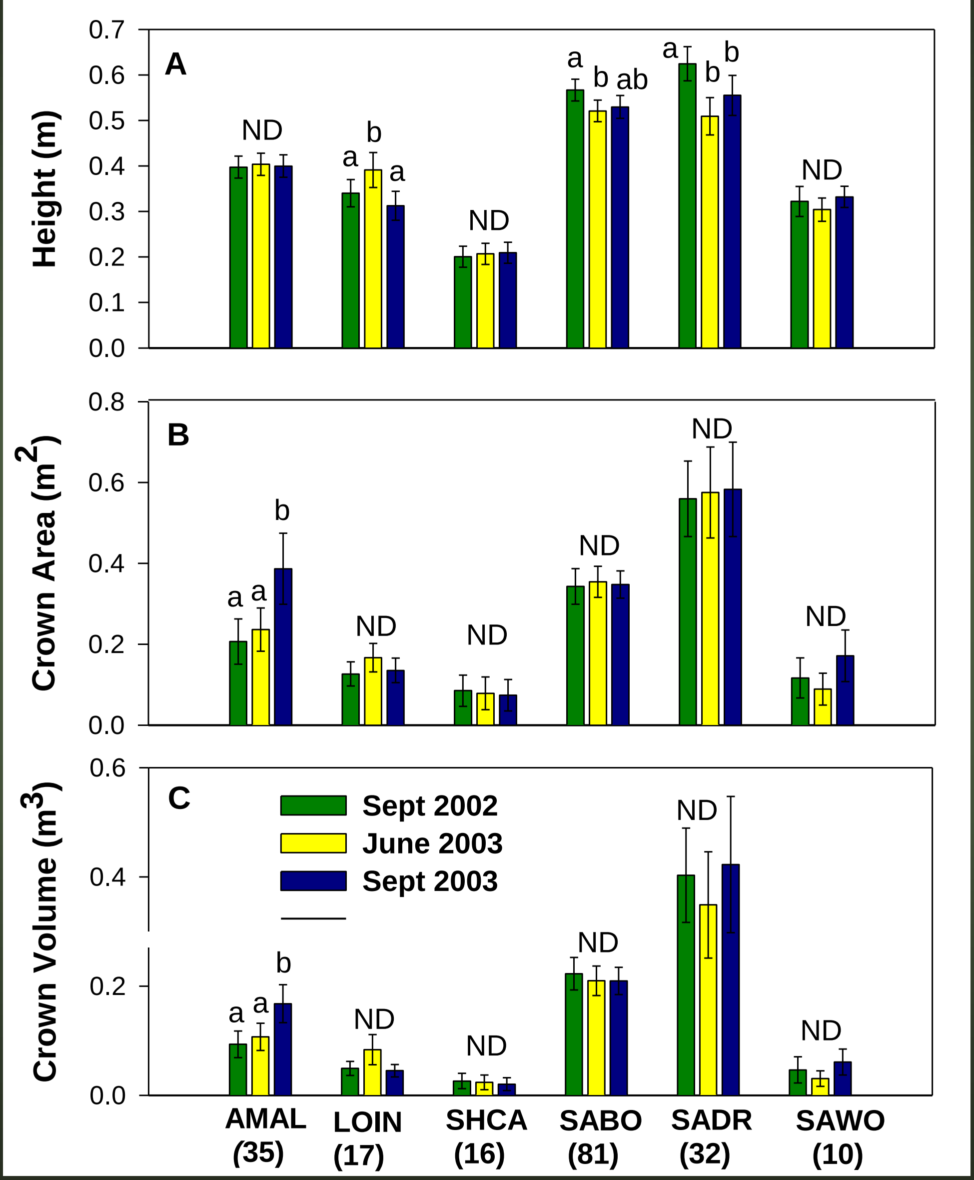
Dwire et al. 2006. Influence of herbivory on regrowth of riparian shrubs following wildland fire. *JAWRA*. 42: 201-212.

Post-Fire Recovery: Riparian Species

Sampled individual shrubs (6 spp.) 3x, 2-3 years post-fire

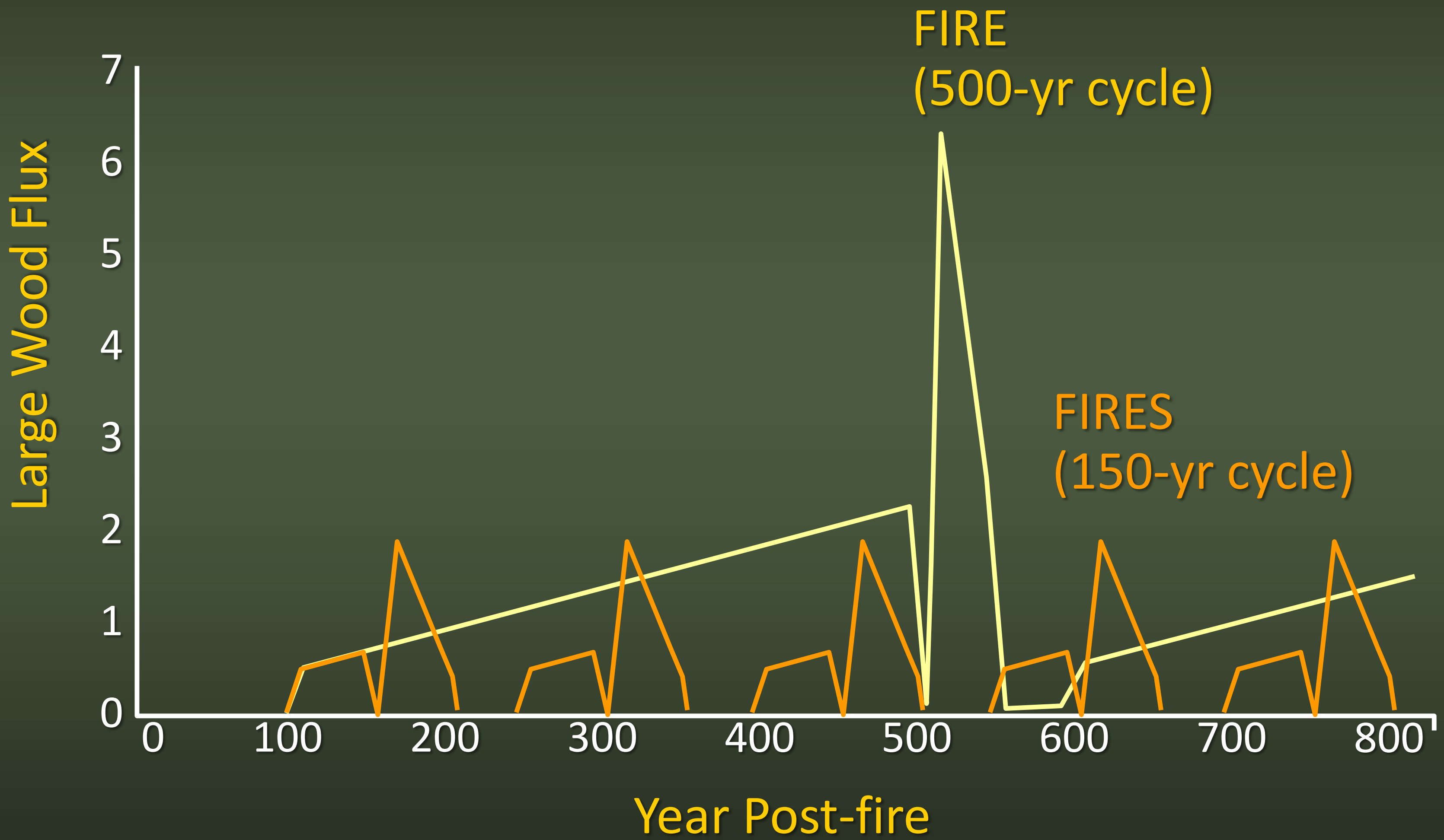
(x ± 1SE; height, crown area, crown volume).

Recovery is strongly influenced by herbivory.



Dwire et al. 2006. Influence of herbivory on regrowth of riparian shrubs following wildland fire. *JAWRA*. 42: 201-212.

Post-Fire Recruitment of Large Wood



From: Benda and Sias 2003

Post-Fire Recruitment of Large Wood

Boulder Creek, Bridger-Teton NF, WY
Severely burned reach (2000)

13 years post-fire:

- ~ 52% of the recruitable wood load has entered the channel;
- ~ 38% has fallen directly on the floodplain;
- ~ 10% still standing, with potential to either enter the channel (wholly or partially) or fall to the floodplain.

Managing and Restoring Riparian Areas in Western Firescapes: Considerations

- Stream shading
- Recruitment of instream & floodplain large wood
- Bank stabilization
- Sediment control
- Inputs of organic matter, & nutrients to stream & floodplain
- Wildlife habitat
- Riparian microclimate
- Vegetative productivity
- Contribution to local & regional biodiversity

Riparian Forest Stand & Fuel Attributes

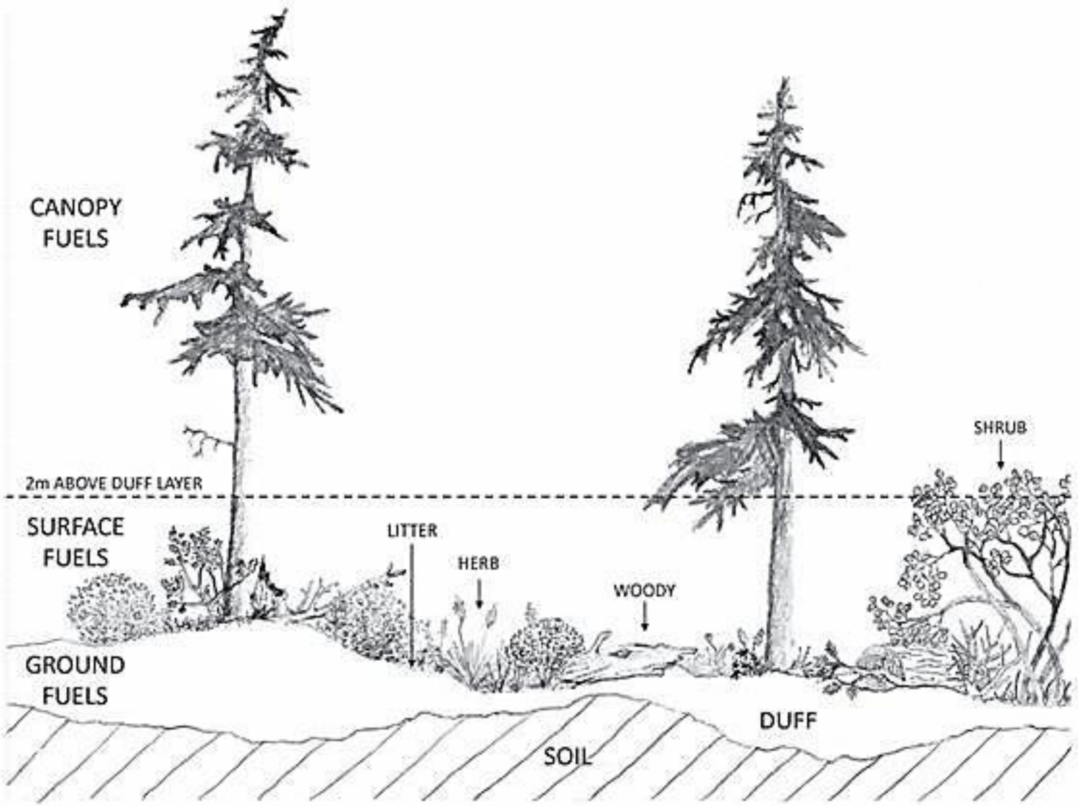


Fig. 1.1 The elements of a typical wildland fuelbed. The full representation of fuels within an area is called a fuelbed. Within a fuelbed, there are three fuel layers: ground, surface, and canopy. Each layer is composed of fuel types, such as litter, shrubs, grasses, and woody biomass in the surface fuel layer

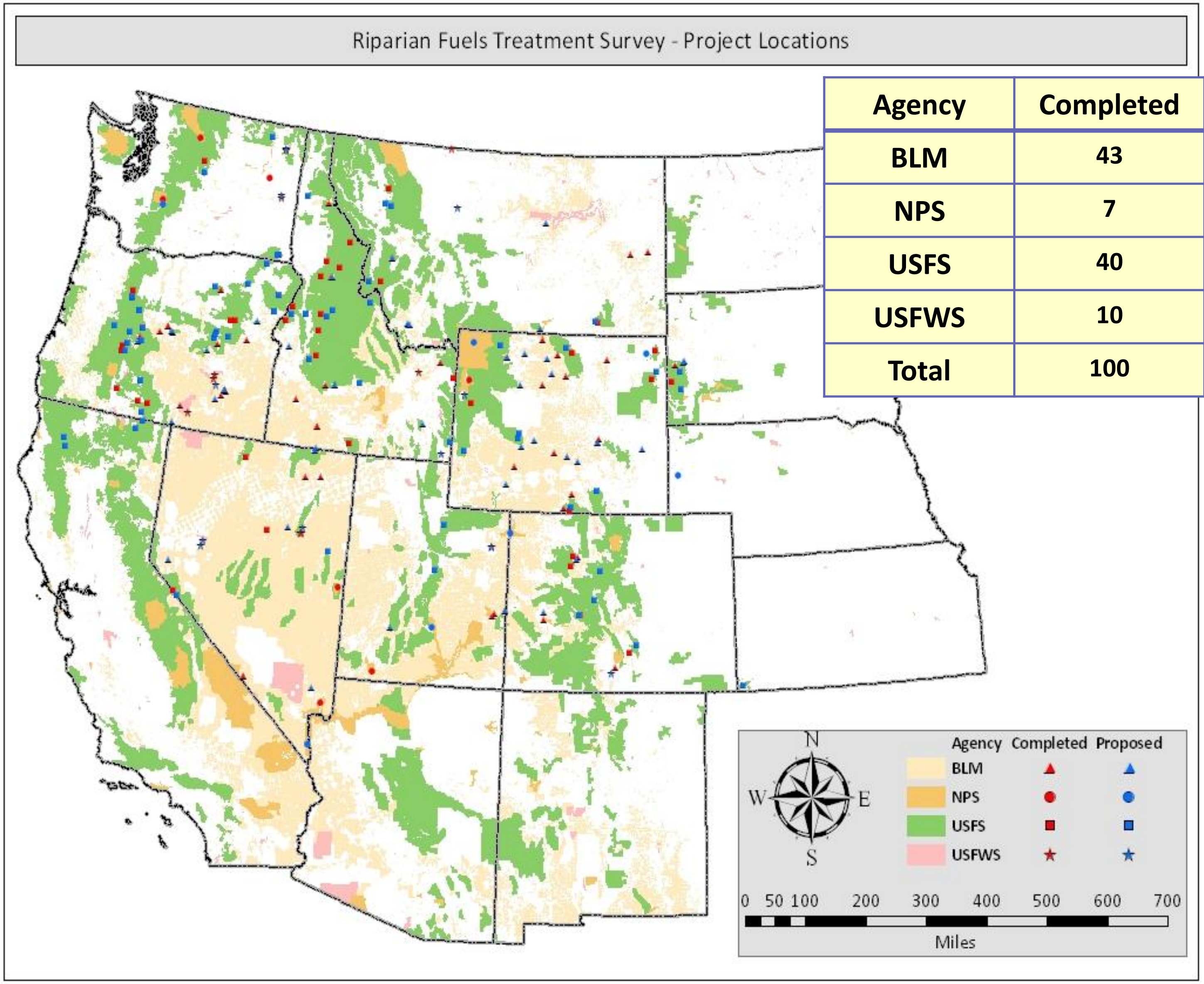
Fuels have been defined & described in the context of inputs to fire behavior models.

Fuels treatments are designed based on existing fuel loads (photo series & other tools).

No fuels estimates / evaluations for riparian vegetation.

From: Keane, R. 2015. Wildland Fuel Fundamentals and Applications. Springer.

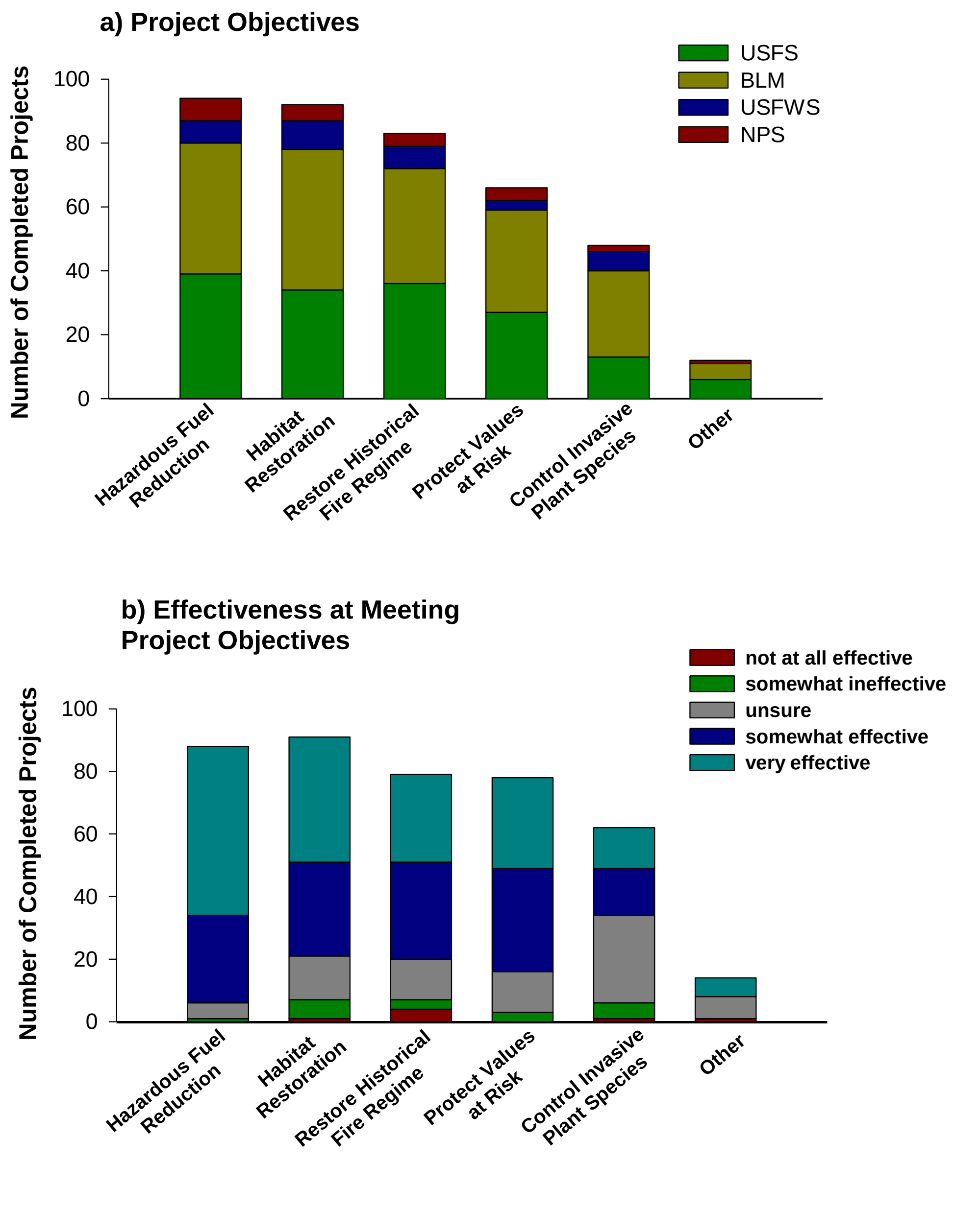
Online Survey: Riparian Fuels Treatments



Agency	Completed	Proposed
BLM	43	45
NPS	7	7
USFS	40	65
USFWS	10	11
Total	100	128

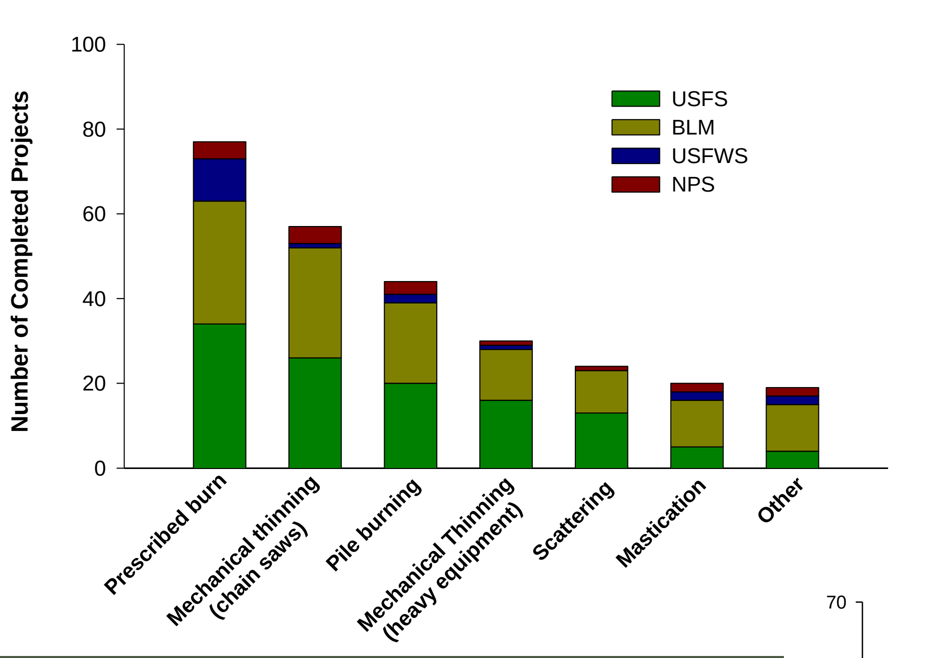
Online Survey: Riparian Fuels Treatments

Project Objectives and Effectiveness

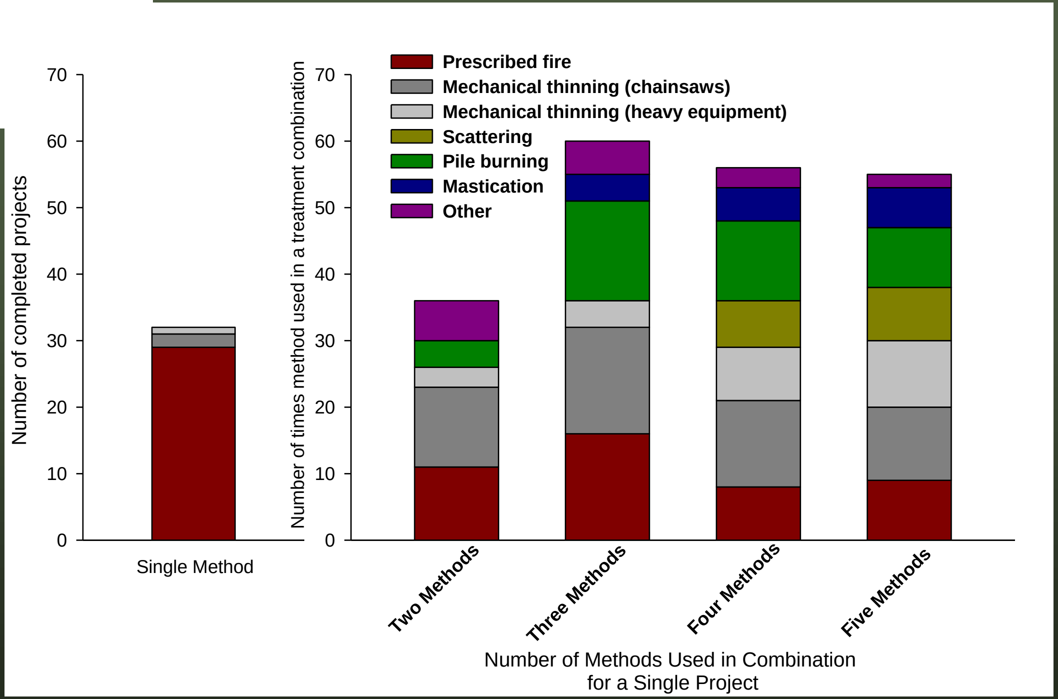


Meyer et al. 2012. Burning questions for managers: Fuels management practices in riparian areas. *Fire Management Today.*

Online Survey: Fuel Treatment Methods



Fontenelle Creek, Bridger-Teton NF, WY

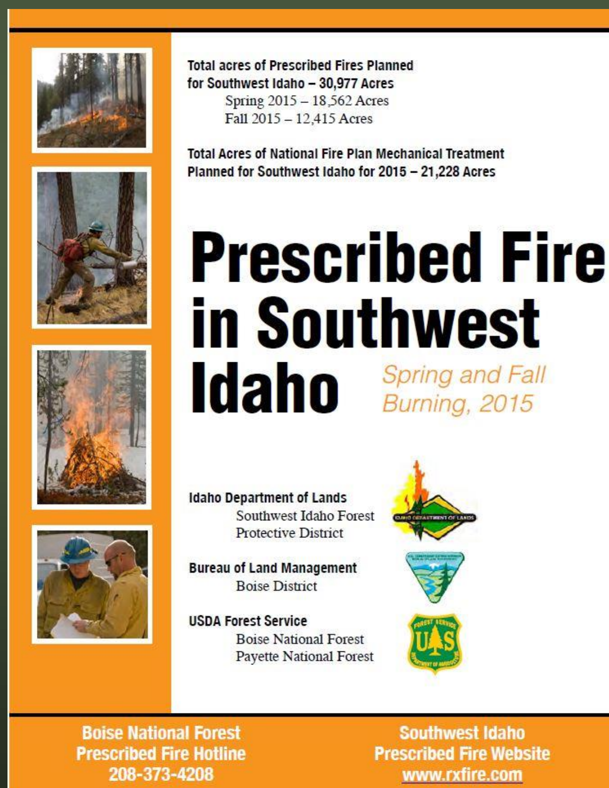


Prescribed Fire It's Good Medicine for our Public Lands

Project Name	Location Legal	Project Type	Description	Acres Treated	Season	Contact
Sam's Pine	T10N, R7E Section(s): 19-35 Lat/long 44.168 -115.653	Prescribed burn using aerial ignition	This project is located approximately 10 air miles northwest of Lowman, Idaho along the Deadwood River.	500	Spring/ Fall 2015	Lowman Ranger District Jason Butler (208) 259-3361

Boise NF:

Rx treatment includes stream-riparian corridors.


Total acres of Prescribed Fires Planned for Southwest Idaho – 30,977 Acres
Spring 2015 – 18,562 Acres
Fall 2015 – 12,415 Acres

Total Acres of National Fire Plan Mechanical Treatment Planned for Southwest Idaho for 2015 – 21,228 Acres

Prescribed Fire in Southwest Idaho

Spring and Fall Burning, 2015

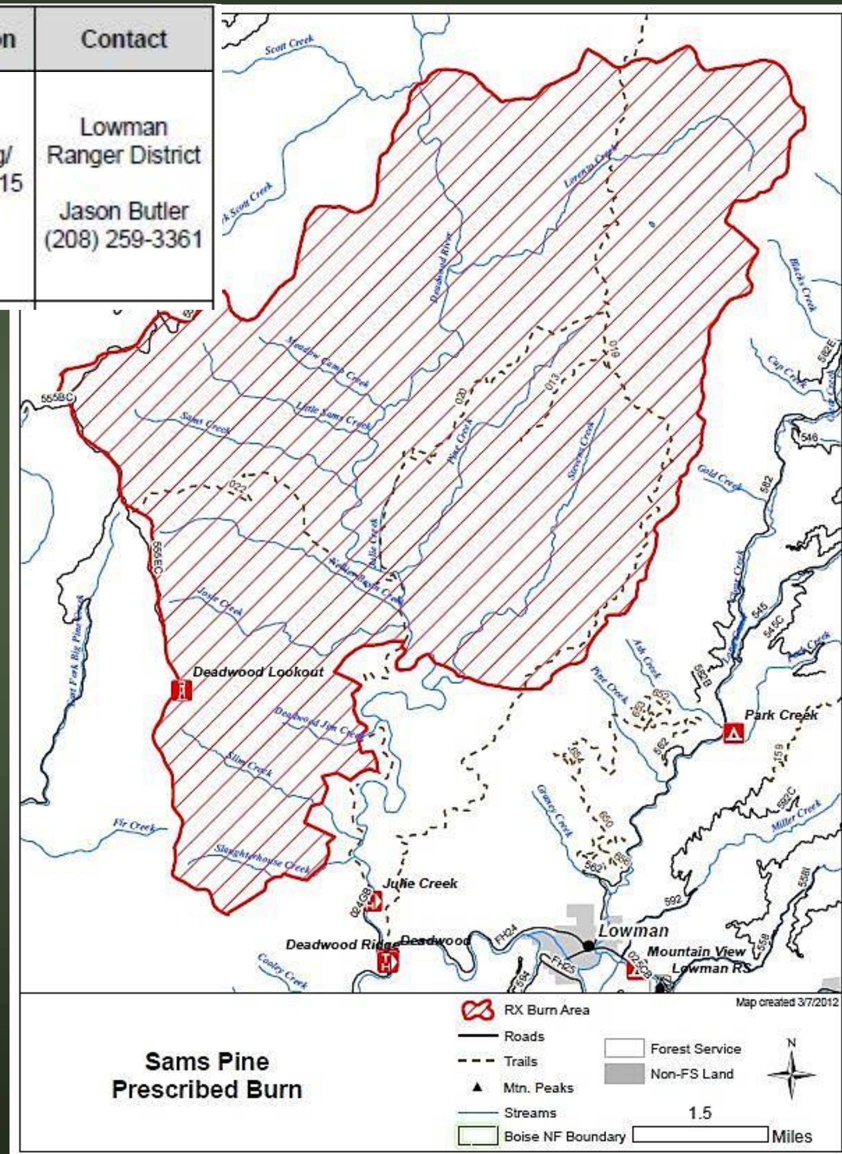
Idaho Department of Lands
Southwest Idaho Forest Protective District

Bureau of Land Management
Boise District

USDA Forest Service
Boise National Forest
Payette National Forest

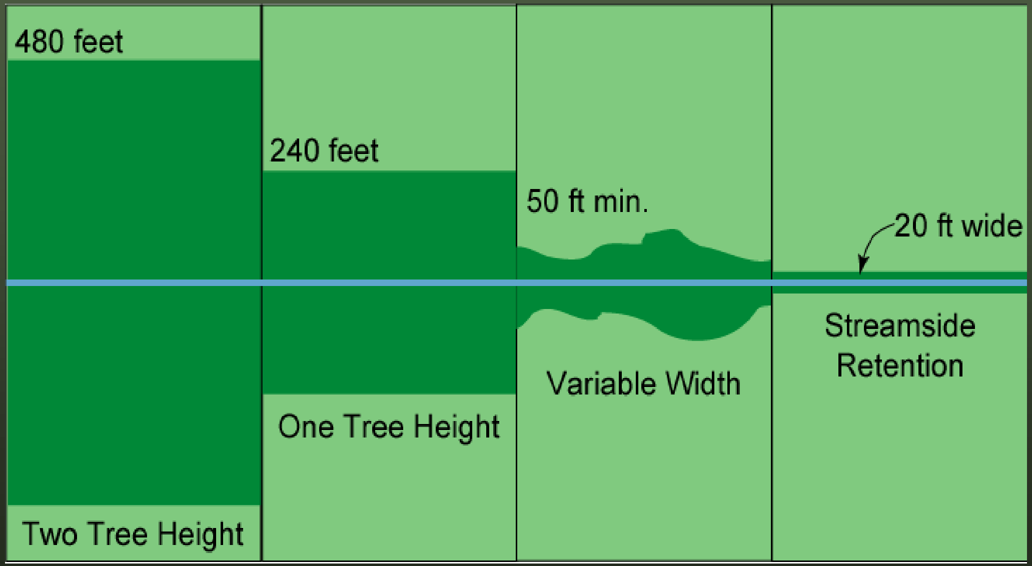
Boise National Forest Prescribed Fire Hotline 208-373-4208

Southwest Idaho Prescribed Fire Website www.rxfire.com

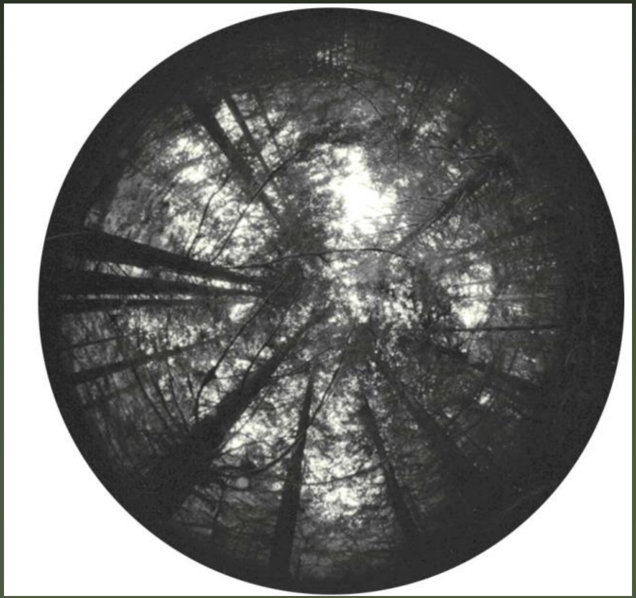


Why Thin in Riparian Areas?

- In bug-infested stands, alter proportion of live/dead;
- Reduce fuels; change fuel structure;
- Promote growth of larger trees in short-and-long-term;
- Accelerate understory vegetation development
  - Deciduous trees & shrubs
  - Shade tolerant regeneration
- Increase spatial heterogeneity at stand level
- Manipulate riparian vegetation (buffers) to enhance specific functions.



Thinning in Riparian Areas: Oregon Coast Range



1) Density Management and Buffer Width Influences on Riparian Microclimate and Microsite (BLM)

Paul D. Anderson

David J. Larson

Samuel S. Chan

2) Buffers with Thinning: Headwater Habitats & Aquatic Vertebrates

Dede Olson

Density management in the 21st century: west side story. Gen Tech Rep. PNW-GTR-880

USDA Forest Service, PNW Research Station

Thinning in Riparian Areas

Define Objectives (target conditions):

- Stand Level
  - Densities
  - Spatial patterns
  - Species composition
  - Short-term and longer term
- Landscape level
  - Proportions of different vegetation types
  - Spatial patterns
  - Relation to successional status of surrounding upland forest

Photos: K. Dwire

Meadow Creek Restoration Project

Location:

- Starkey Experimental Forest & Range
- Wallowa Whitman NF, NE Oregon

Meadow Creek

- Tributary to Grande Ronde River;
- Study reach ~ 13 km within Starkey
- Spawning habitat for steelhead; Juvenile rearing habitat for steelhead & chinook salmon

Partners:

Bonneville Power Administration; Columbia River Intertribal Fish Commission; Grande Ronde Model Watershed; Oregon Dept of Fish & Wildlife; Oregon State University; USDA Forest Service PNW; Wallowa Whitman NF

Information in slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

Meadow Creek Restoration Project

Research objective: Evaluate habitat and population recovery of salmonids under varying levels of cattle, elk, and mule deer herbivory.

Management Objectives:

- Assess impacts of herbivory (livestock vs deer/elk) on shrub recovery
- Establish BMPs for recovery of riparian ecosystems

Information in slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

Meadow Creek Restoration Project

- Began in 2012
- Includes:
  - In-stream placement of boulders and logs throughout creek
  - Planting of seedlings and cuttings in riparian areas
  - Construction of new cattle pasture fences and research exclosures
  - Protective “pods” around ~50% of deciduous seedlings

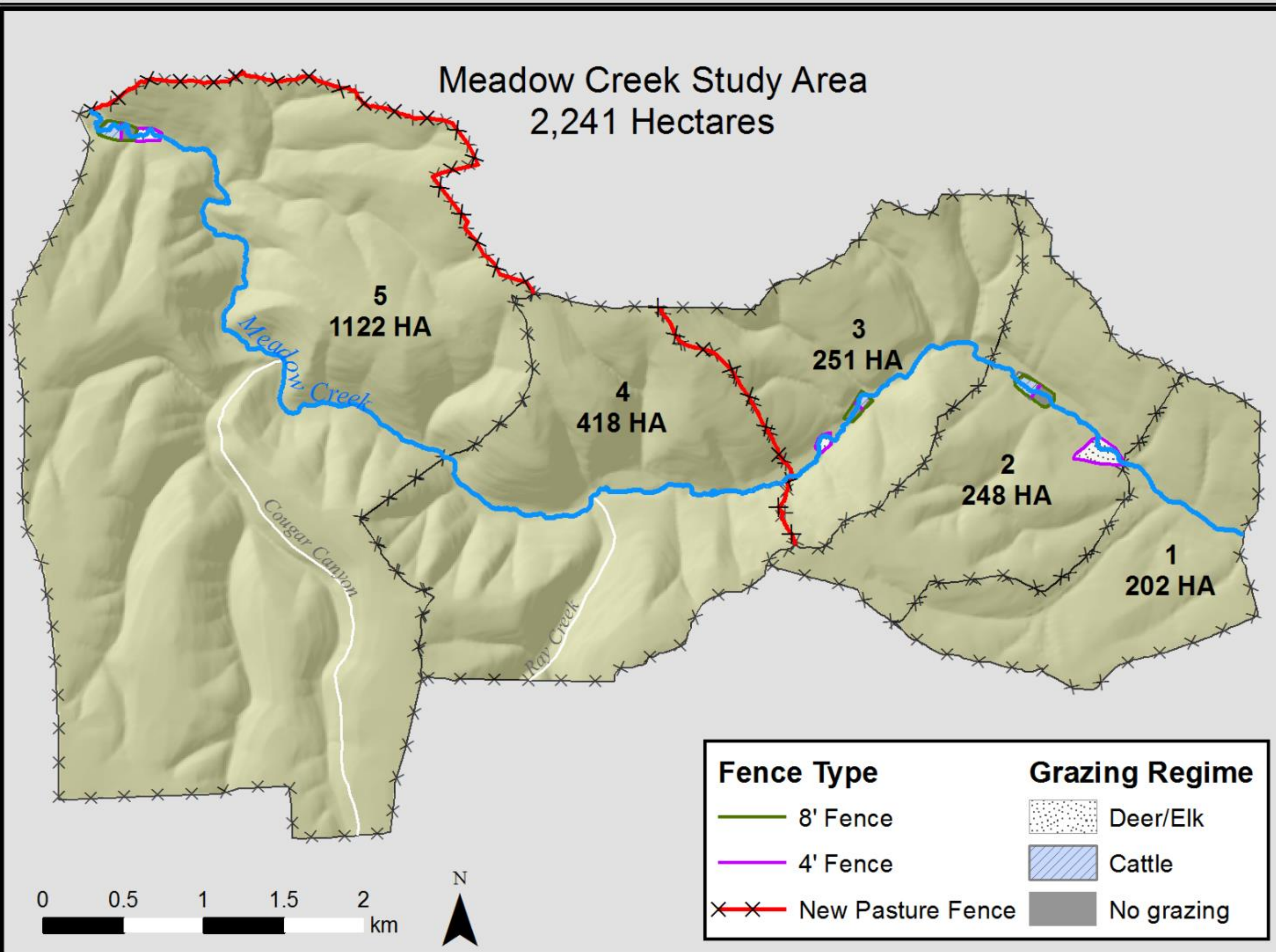


Slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

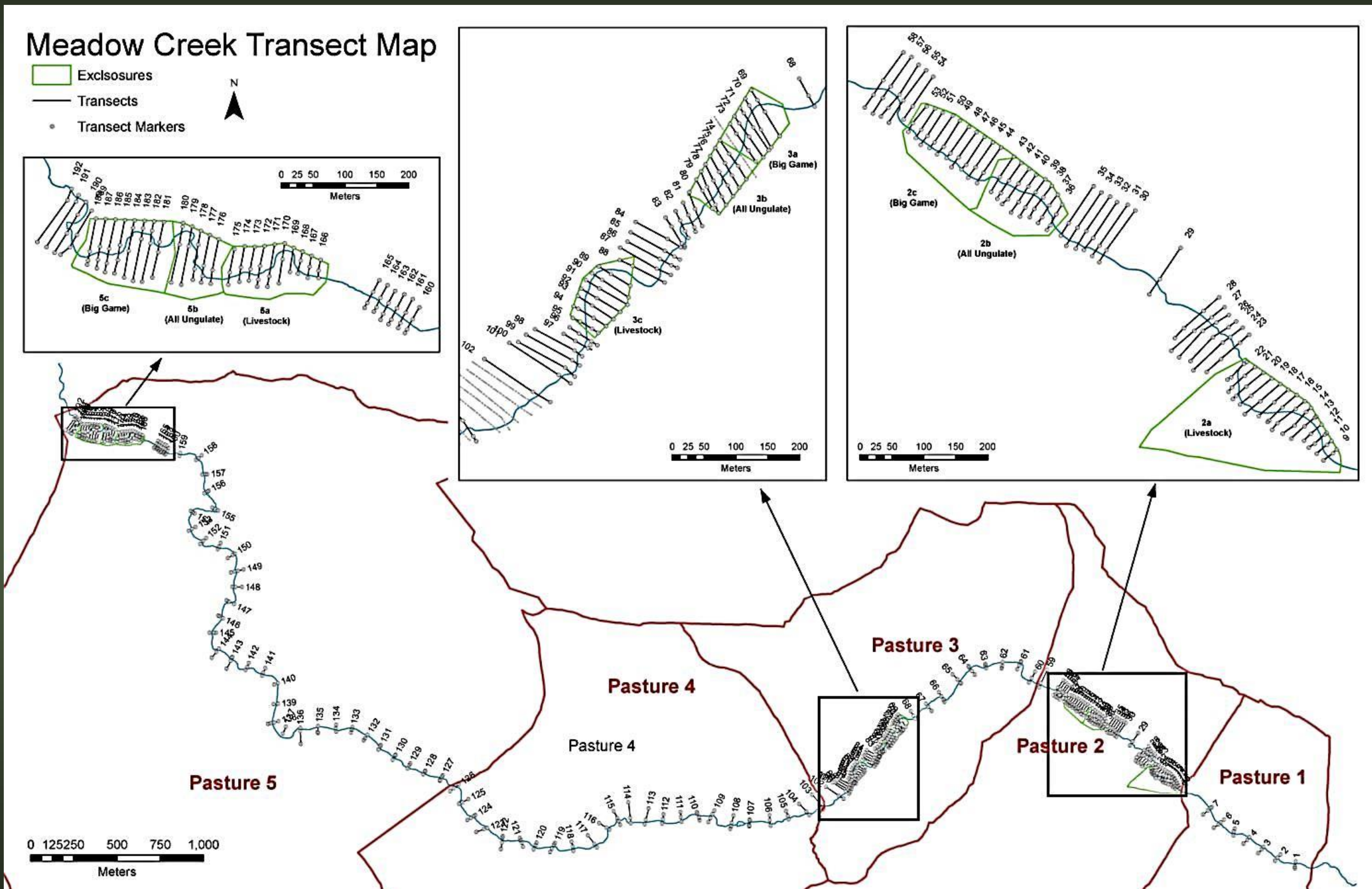
Meadow Creek: Experimental Design

- Four levels of herbivory:
  - Deer and elk effect (cattle excluded)
  - Cattle effect (deer and elk excluded)
  - Complete protection (all ungulates excluded)
  - Deer, elk, and cattle effect (extant grazing by all ungulates)
- Exclosures ~1 ha each
- Replicated in 3 of the 5 pastures

Slide provided by Mary Rowland, PNW Research Station, LaGrande, OR


Meadow Creek Study Area
2,241 Hectares
5
1122 HA
4
418 HA
3
251 HA
2
248 HA
1
202 HA
Meadow Creek
Cougar Canyon
Ray Creek
Fence Type
8' Fence
4' Fence
New Pasture Fence
Grazing Regime
Deer/Elk
Cattle
No grazing
0 0.5 1 1.5 2 km
N

Meadow Creek Restoration Project



Slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

Meadow Creek Restoration Project

Methods to monitor riparian vegetation:

- Plantings monitored along 4-m linear belt transects;
- Detailed data collected on plantings;
- Line transects for deciduous woody shrub canopy cover, composition, and structure across 4 grazing treatments;
- Intensive greenline monitoring of vegetation and soils;
- Utilization monitoring after cattle in system in 2016.

Slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

Meadow Creek Restoration Project

Initial results:

- Current levels of deer and elk herbivory along Meadow Creek have measurable impacts on the performance of restoration plantings;
- Herbivory effects also impact recovery of riparian habitat for fish and other resources;
- Large-scale restoration projects should account for herbivory impacts where wild ungulates are present.

Slide provided by Mary Rowland, PNW Research Station, LaGrande, OR

Meadow Creek Restoration Project

Evaluation of:

- Cost effectiveness of new cattle grazing system;
- Cattle diets and distribution in riparian vs upland communities;
- Effects of riparian plantings on fish habitat and populations;
- Long-term changes in riparian vegetation from restoration plantings;
- Long-term changes in riparian plant community composition;
- Modeled effects of riparian restoration on stream; temperature under climate change scenarios;
- Effects of deer and elk vs. cattle herbivory on small mammals and floral resources for native bees.

Information on slide provided by Mary Rowland, PNW Research Station, LaGrande, OR


Photo: S. Wondzell

MFJDR Modeling Study: Stream T Projections

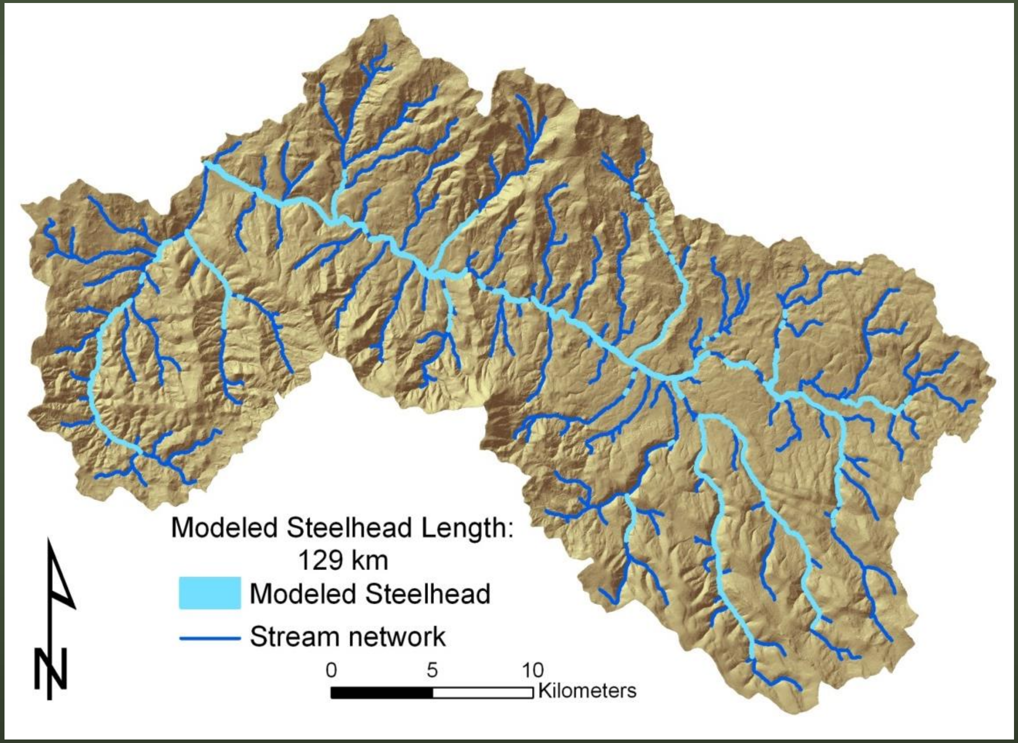
MFJDR

- Tributary to the John Day River;
- Spawning habitat for steelhead;
- Juvenile rearing habitat for steelhead & chinook salmon

Study Location:

- 37-km reach of the Middle Fork John Day River (MFJDR), NE Oregon

Steelhead – High Intrinsic Potential (IP > 0.75)



Unpublished: Wondzell & Przeszlowska

Information on slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

MFJDR Modeling Study: Stream T Projections

Research Question: **Can restoration of riparian vegetation along degraded stream segments mitigate warming stream temperatures due to climate change or fire?**

Clear Creek – Upstream View

Clear Creek – Downstream View

Information on slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

Photos: S. Wondzell

MFJDR Modeling Study: Stream T Projections

Modeling Design:

Used a mechanistic stream T model (HeatSource) to examine future changes in stream T :

Photo: S. Wondzell

1) + 4 C increase in air T;
2) ± 30% changes in stream Q;
3) Four riparian vegetation scenarios:

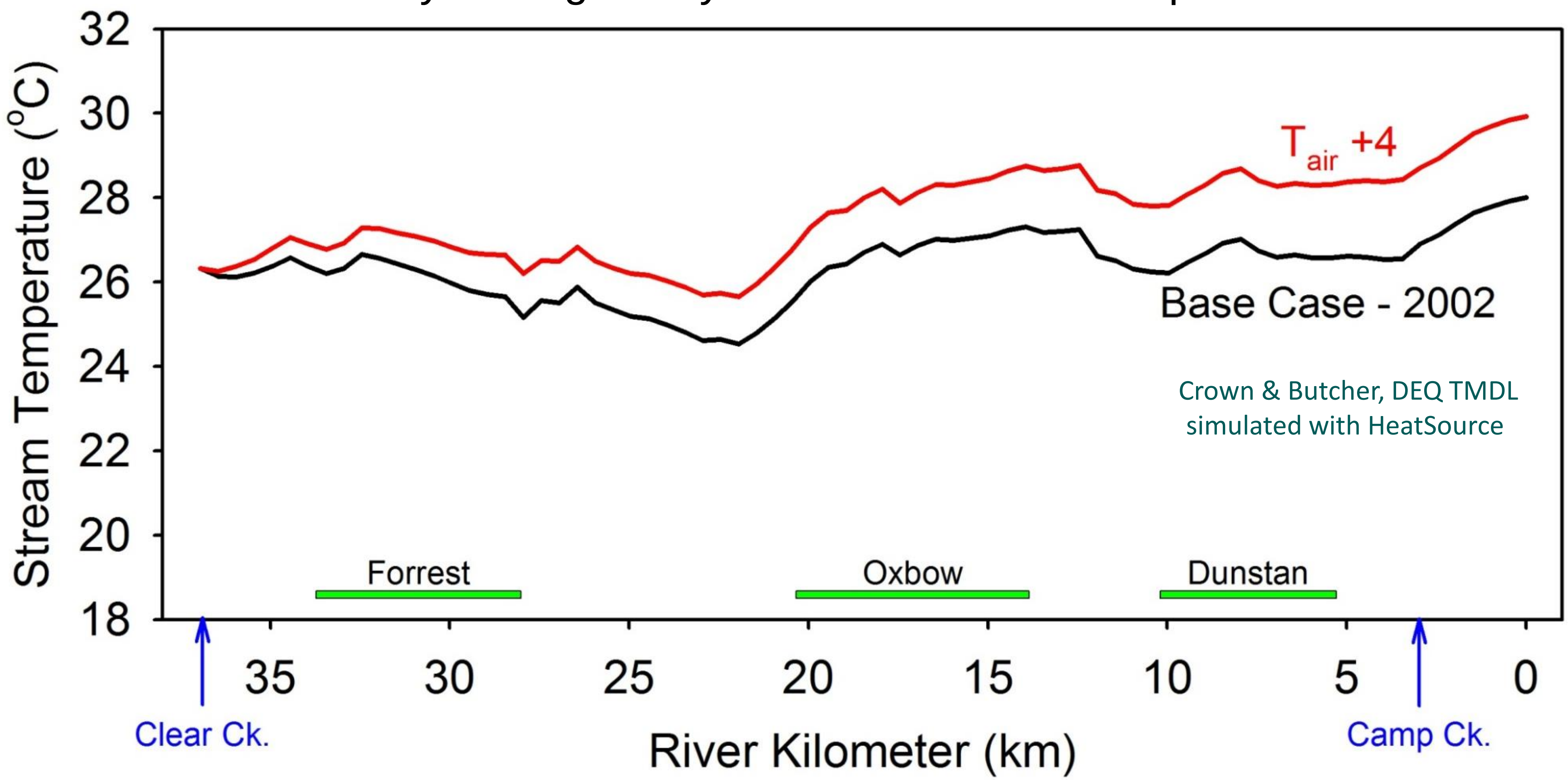
- current conditions, ave. effective stream shade = 19%;
- Post-fire scenario: max vegetation height = 1m, 10% canopy density, effective stream shade = 7%;
- Intermediate condition: young-open forest or tall-shrub; vegetation height = 10-m, 30% canopy density, effective stream shade =34%;
- Restored riparian forest, trees 30-m ht, 50% canopy density, effective stream shade = 79%

Information on slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR
Photo: Google Map

37-km Study Reach of Middle Fork John Day River

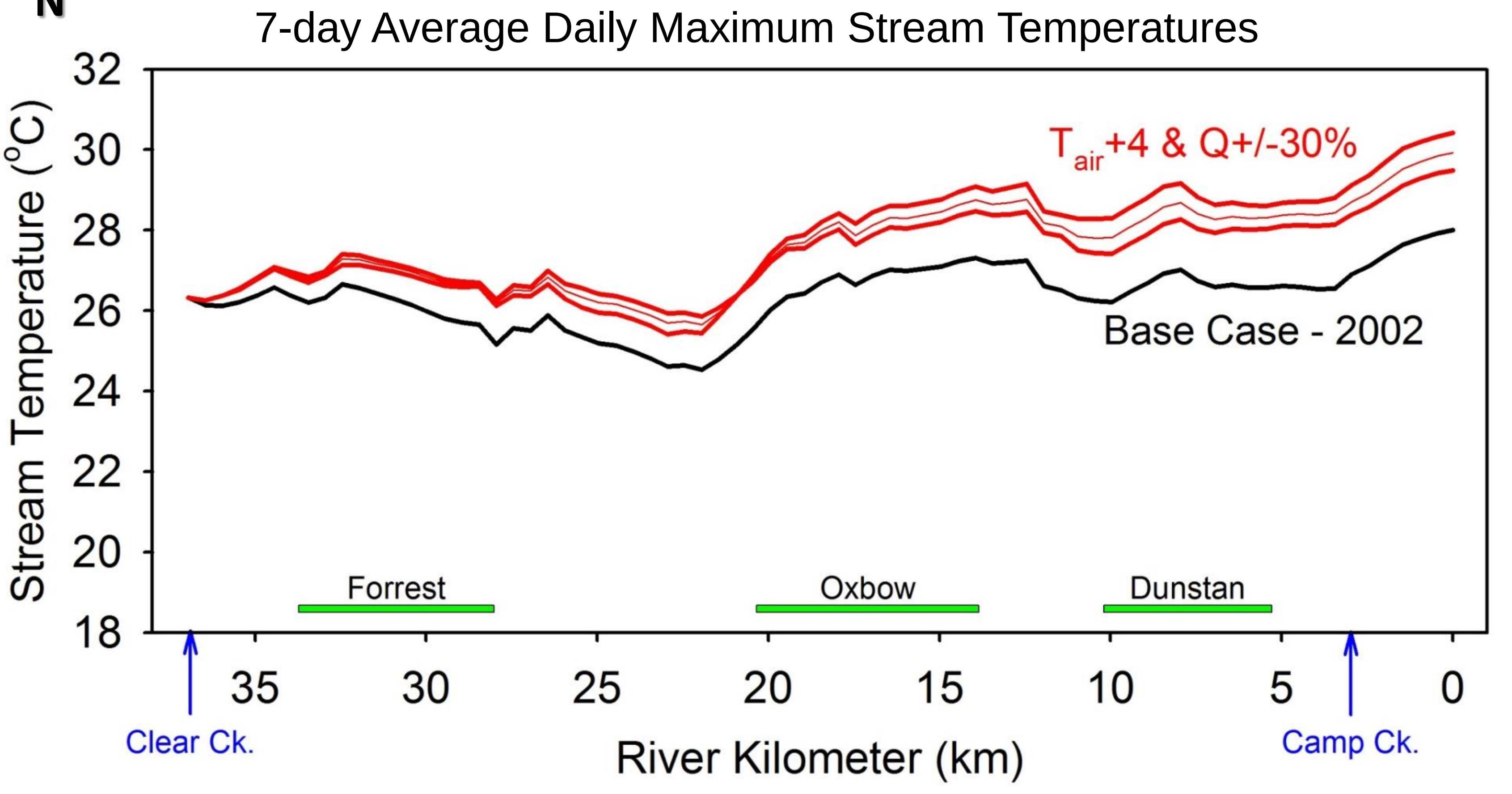
7-day Average Daily Maximum Stream Temperatures



Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

(Diabat, Wondzell, & Haggerty, in prep.)

37-km Study Reach of Middle Fork John Day River



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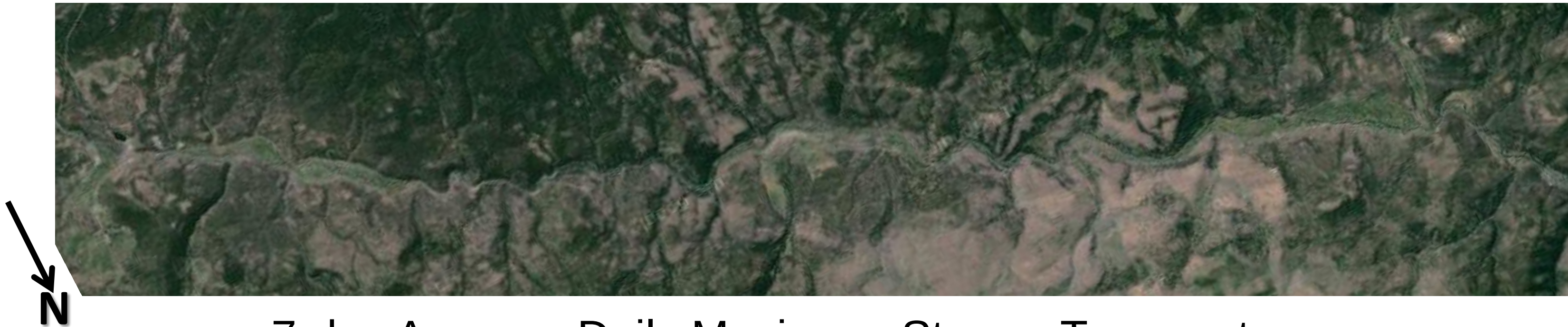
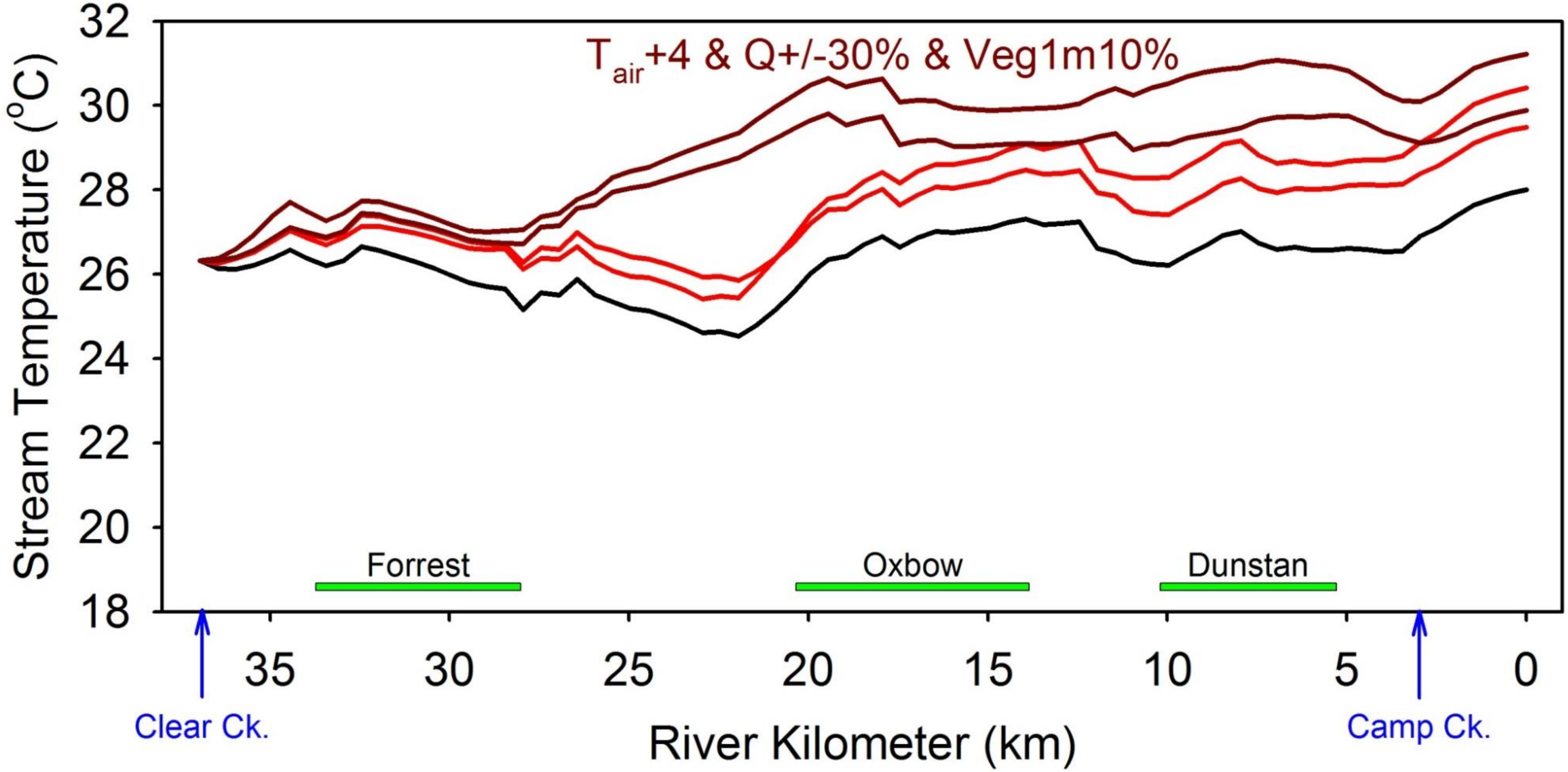
37-km Study Reach of Middle Fork John Day River



7-day Average Daily Maximum Stream Temperatures



Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

(Diabat, Wondzell, & Haggerty, in prep.)

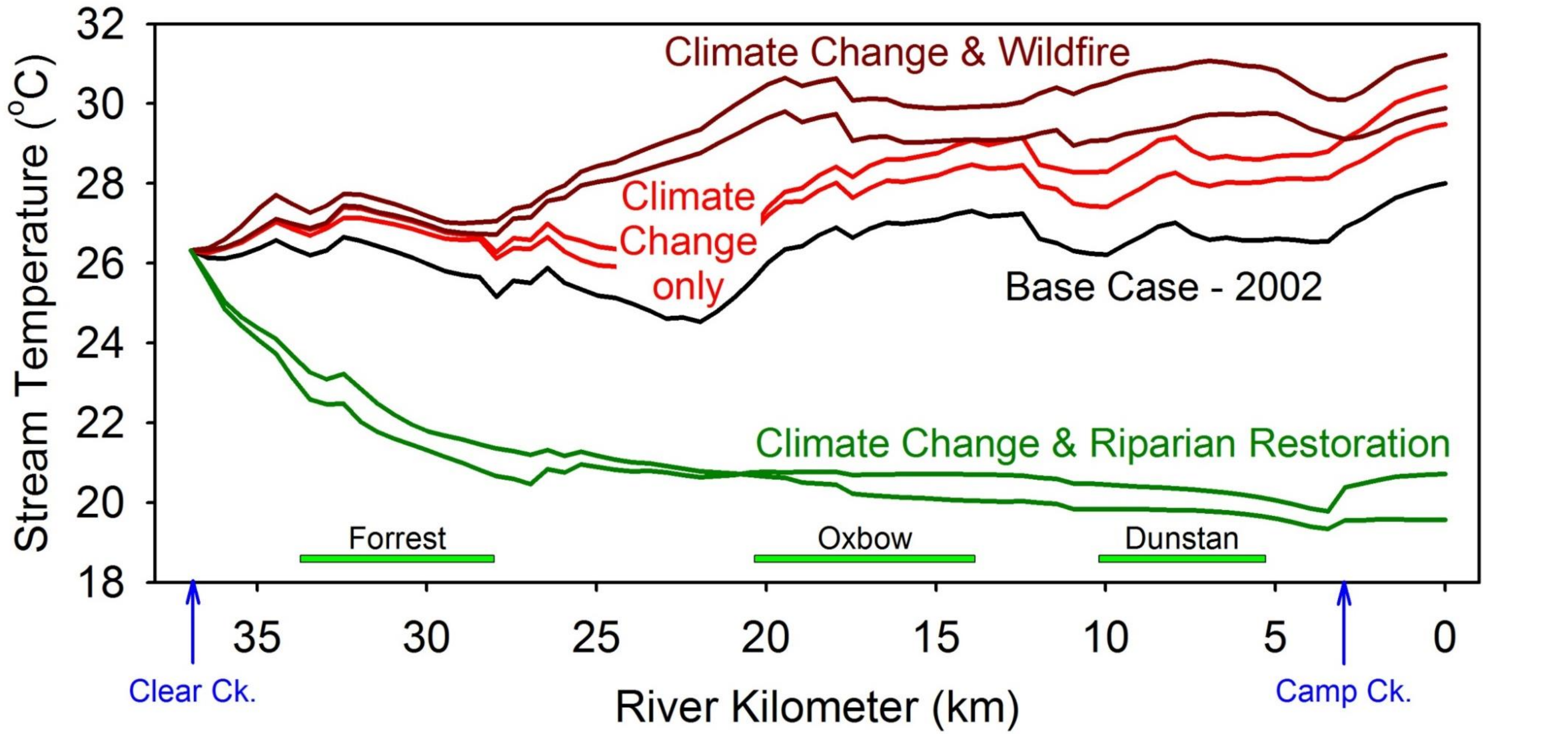
Can we grow more shade?

Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

Photo: S. Wondzell

37-km Study Reach of Middle Fork John Day River

7-day Average Daily Maximum Stream Temperatures



Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

(Diabat, Wondzell, & Haggerty, in prep.)

MFJDR Modeling Study: Stream T Projections

Modeling Results:

1) Composition & structure of riparian vegetation were the most important factors determining future stream T;
2) Changing air T or stream Q had relatively small influence on future stream T;
3) Post-wildfire and current-vegetation scenarios were warmer than today, but effective shade was low, so stream T sensitive to air T (climate change);
4) Intermediate restoration – young forest or tall-shrub dominated- cooler than today;
5) Biggest change resulted from restoring the riparian forest – decreased summer max stream T by ~ 7.

Photo: S. Wondzell

Information in slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

Fenced to exclude livestock, tilled,
and landscape cloth used to limit competition
~46,000 native hardwoods planted 2006

Slide provided by Steve Wondzell, PNW Research Station, Corvallis, OR

Photo: S. Wondzell

Managing and Restoring Riparian Areas in Western Firescapes

Pre-fire

- Increase resilience by managing for riparian ecological condition within the natural disturbance regime;
- Restore natural riparian conditions, especially along severely altered stream segments, in concert with in-channel restoration and upland management (watershed context);
- Allow for natural disturbance.

Post-fire

- Eliminate livestock grazing until shrubs recover;
- Limit salvage logging; let the burnt trees enter the channel;
- Allow for post-fire processes.

Thank You!